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(54) Float circuit for boom of construction apparatus.

(57) A float circuit for a boom of a construction equipment, particularly a hydraulic shovel, which can put the boom into a floating condition. The float circuit comprises a boom cylinder (5) for operating the boom, a directional control valve (8), a pair of operating circuits (20, 21) for communicating the boom cylinder and the directional control valve, and a selector valve (27) connected between the operating circuits and having an interrupting oil path position and a float oil path position. When the selector valve assumes the interrupting oil path position, the operating circuits are not communicated with each other, and consequently, the boom cylinder is not brought into a floating condition. But if the selector valve is changed over from the interrupting oil path position to the float oil path position, then the operating circuits are communicated with each other so that the boom cylinder can be brought into a floating condition.

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Float Circuit for Boom of Construction Apparatus

This invention relates to a float circuit for a boom of a construction apparatus such as a hydraulic shovel.

A hydraulic shovel, which as an example of construction apparatus, commonly has a general construction as shown in Fig. 5. Referring to Fig. 5, the hydraulic shovel shown includes a lower structure 1, an upper rotating structure 2, and a working attachment 3 mounted on a front portion of the upper rotating structure 2. The working attachment 3 includes a boom 4, a boom cylinder 5, an arm 6, and a bucket 7. The hydraulic shovel normally includes a hydraulic circuit for operation of the components thereof as shown in Fig. 6. Referring to Fig. 6, the hydraulic circuit shown includes a directional control valve 8 for the boom cylinder 5. The directional control valve 8 has a pair of pilot pressure receiving portions 9 and 10. The hydraulic circuit further includes a remote control valve 11, a main pump 12, and a pilot pump 13. When the boom 4 is to be pivoted upwardly or downwardly, an operating lever 14 of the remote control valve 11 is manually operated to tilt in either direction to a position A or position B. Consequently, pilot hydraulic pressure from the pilot pump 13 acts, by way of an oil path 15, one of a pair of pilot valves 16 and 17 of the remote control valve 11 and another oil path 18 or 19, upon the pilot pressure receiving portion 9 or 10 of the directional control valve 8. Thereupon, the directional control valve 8 is changed over to allow pressure oil from the main pump 12 to be supplied into the boom cylinder 5 by way of a corresponding one of a pair of operating circuits 20 and 21.

Meanwhile, a float circuit is a circuit which allows the two sides of a double acting hydraulic cylinder to communicate freely for a boom is employed, for example, in a hydraulic circuit for a wheel loader which is a kind of working vehicles. Fig. 7 shows part of an exemplary hydraulic circuits for a wheel loader (not shown) which includes a float circuit for a boom. Referring to Fig. 7 the hydraulic circuit shown includes a boom cylinder 22 of the wheel loader, a control valve 23 for the boom cylinder 22 having an operating lever 24. A detecting coil 25 is provided for the control valve 23. The control valve 23 has four positions including a neutral oil path position C, a raising oil path position D, a lowering oil path position E and a float oil path position F. When a snow removing operation or a back dozer operation is to be carried out with the wheel loader, the control valve 23 is operated to be changed over to the float oil path position F to carry out such operation.

Such float circuit, however, cannot be incor-

porated as it is in such a hydraulic circuit as shown in Fig. 2 for the following reason.

In particular, when a grading operation is to be carried out with the hydraulic shovel described above, if the boom can be put into a floating condition, then the hydraulic shovel can carry out a grading operation similarly to a bulldozer. Also, grading can be carried out by stopping movement of the hydraulic shovel and contracting the arm.

In the hydraulic shovel, however, when the directional control valve for a boom is to be changed over, the operating lever of the remote control valve is tilted. Consequently, where the float oil path position is provided as part of the directional control valve, there is the possibility that an error in operation may occur which may be dangerous. Accordingly, the float oil path position should not be provided as part of the directional control valve for a boom.

We will describe a float circuit for a boom which can put the boom into a floating condition.

According to the present invention, there is provided a float circuit for a boom of a construction apparatus of the type which includes a lower structure, an upper rotating structure on the lower structure, a working attachment mounted on a front portion of the upper rotating structure, and a boom for the working attachment, which float circuit comprises a boom cylinder for operating the boom, a directional control valve, a pair of operating circuits for communicating the boom cylinder and the directional control valve, and a selector valve connected between the operating circuits and having an interrupting oil path position in which the operating circuits are not communicated with each other and a float oil path position at which the operating circuits are communicated with each other by way of the selector valve to allow the boom cylinder to assume a floating condition.

With the float circuit, when the selector valve assumes the interrupting oil path position, the boom cylinder is not brought into a floating condition, but if the selector valve is changed over from the interrupting oil path position to the float oil path position, then the operating circuits are communicated with each other so that the boom cylinder can be brought into a floating condition.

Preferably, the selector valve is a solenoid operated valve connected to be operated by an electric circuit which includes a manually operable switch of the automatic returning type and a switch of the manual contact type connected in series to the manually operable switch. When the switch of the manual contact type is in an off-state, the solenoid operated valve assumes the interrupting

oil path position, and consequently, even if the manually operable switch of the automatic returning contact type is operated into an on-state, the boom cylinder is not brought into a floating condition. However, if the switch of the manual contact type is operated into an on-state and then the manually operable switch of the automatic returning contact type is operated into an on-state, then the solenoid operated switch is changed over from the interrupting oil path position to the float oil path position to allow the boom cylinder to be brought into a floating condition. Then, only while the manually operable switch of the automatic returning contact type is held operated in the on-state, can the boom cylinder assume such floating condition.

Where the boom circuit is incorporated in a construction apparatus such as, for example, a hydraulic shovel, when the boom cylinder is in a floating condition, the hydraulic shovel can carry out a grading operation. Further, if the manually operable switch of the automatic returning contact type is operated suitably, a soil compacting operation or a pile driving operation or the like can be carried out by a bucket of the hydraulic shovel. Accordingly the usefulness of the hydraulic shovel is improved.

The above and other objects, features and advantages of the present invention will become apparent from the following description and the appended claims, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a circuit diagram of a float circuit for a boom showing a preferred embodiment of the present invention;

Fig. 2 is a similar view but showing another preferred embodiment of the present invention;

Figs. 3 and 4 are similar views but showing different preferred embodiments of the present invention;

Fig. 5 is a side elevational view of a construction apparatus in the form of a hydraulic shovel;

Fig. 6 is a circuit diagram of an example of a conventional hydraulic circuit for use with the hydraulic shovel shown in Fig. 5; and

Fig. 7 is a circuit diagram of a hydraulic circuit for a wheel loader.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to Fig. 1, there is shown a hydraulic circuit of a float circuit for a boom according to the present invention. Since the float circuit has

substantially similar construction to that of the hydraulic circuit shown in Fig. 6 and is incorporated, for example, in such a hydraulic shovel as shown in Fig. 5, like parts or elements are denoted by like reference characters and the following description will proceed with reference also to the hydraulic shovel shown in Fig. 5. This also applies to the following embodiments of the present invention described hereinbelow.

The hydraulic circuit shown in Fig. 1 has a substantially similar construction to that of the hydraulic circuit shown in Fig. 6 but additionally includes a selector valve 26 with a float oil path position. In particular, the selector valve 26 is provided between a pair of operating circuits 20 and 21 which communicate a boom cylinder 5 and a directional control valve 8 for the boom cylinder 5. The selector valve 26 is manually movable to an interrupting oil path position G or a float oil path position H. When the selector valve 26 is at the interrupting oil path position G, the operating circuits 20 and 21 are separated from each other so that the boom cylinder 5 cannot be brought into a floating condition. In this condition, the hydraulic shovel functions as the conventional hydraulic shovel described above. However, if the selector valve 26 is changed over from the interrupting oil path position G to the float oil path position H, then the operating circuits 20 and 21 are communicated with each other by way of the selector valve 26 so that the boom cylinder 5 is put into a floating condition. Consequently, the hydraulic shovel can carry out a grading operation or the like.

Fig. 2 shows another float circuit for a boom according to the present invention. Referring to Fig. 2 the float circuit shown includes, in place of the selector valve 26 of the float circuit shown in Fig. 1, a solenoid controlled valve 27 as a selector valve with a float oil path position. The solenoid controlled valve 27 also has an interrupting oil path position I and a float oil path position J. The solenoid controlled valve 27 includes a solenoid 28 which is electrically connected to an electric circuit 29. The electric circuit 29 for the solenoid 27 of the solenoid controlled valve 27 includes a switch 30 of the manual contact type and a power source 31. When the manual contact type switch 30 is manually operated into an on-state, the solenoid operated valve 27 is changed over from the interrupting oil path position I to the float oil path position J. The solenoid operated valve 27 operates in a similar manner to that of the selector valve 26 described above. It is to be noted that the solenoid operated valve 27 may be replaced by a pilot valve with a float oil path position which is changed over in response to a pilot pressure acting thereupon.

Referring now to Fig. 3, there is shown a float circuit for a boom of a further preferred embodi-

ment of the present invention. The float circuit shown includes a solenoid operated valve 27 similar to that of the float circuit shown in Fig. 2, but includes an electric circuit 32 which is different in construction from the electric circuit 29 shown in Fig. 2. In particular, the electric circuit 32 includes, in addition to the manual contact type switch 30 and the power source 31, a manually operable switch 33 of the automatic returning contact type.

The manual contact type switch 30 and the returning contact type switch 33 are connected in series in the electric circuit 32. When the manual contact type switch 30 is in an off-state, the solenoid operated valve 27 assumes its interrupting oil path position I, and consequently, even if the returning contact type switch 33 is manually operated into an on-state, the boom cylinder 5 will not be put into a floating condition. On the other hand, if the manual contact type switch 30 is manually operated into an on-state and then the returning contact type switch 33 is manually operated into an on-state, then the boom cylinder 5 is put into a floating condition. The boom cylinder 5 remains in the float condition only while the returning contact type switch 33 is held in the on-state.

In operation, the manual contact type switch 30, for example, is manually operated into an on-state and then the directional control valve 8 is changed over to a boom raising oil path position K to raise the boom. Then, when the bucket at the end portion of the working attachment is raised to a required vertical position, the returning contact type switch 33 is operated into an on-state. Consequently, the boom cylinder 5 is changed into a floating condition to allow the bucket to drop or fall together with the boom. In this condition, if the returning contact type switch 33 is suitably operated into an on-state and/or an off-state at suitable timings, then a compacting operation for the soil or a pile driving operation by the bucket can be carried out.

Referring now to Fig. 4, there is shown a float circuit for a boom of a still further embodiment of the present invention. The float circuit shown includes, instead of the solenoid operated valve 27 of the float circuit of Fig. 3, a pilot valve 34 as a selector valve with a float oil path position and a solenoid operated selector valve 36 for controlling pilot pressure from the pilot pump 13 to act upon a pilot pressure receiving portion 35 of the pilot valve 34. The pilot valve 34 is provided between the operating circuits 20 and 21 similarly to the solenoid operated valve 27 while a solenoid 37 of the solenoid operated selector valve 36 is connected to an electric circuit 32' which has a substantially same construction as the electric circuit 32 described hereinabove. Thus, except that the pilot valve 34 as a selector valve with a float oil path

position is controlled by pilot pressure which is controlled by the solenoid operated selector valve 36, the float circuit operates substantially in a similar manner to that of the float circuit shown in Fig. 3.

Claims

1. A float circuit for a boom of construction apparatus of the type which includes a lower structure (1), an upper rotating structure (2) on said lower structure (1), a working attachment (3) mounted on a front portion of said upper rotating structure (2), and a boom (4) for said working attachment (3), comprising a boom cylinder (5) for operating said boom (4), a directional control valve (8), a pair of operating circuits (20,21) for communicating said boom cylinder (5) and said directional control valve (8), and a selector valve (26,27,34) connected between said operating circuits (20,21) and having an interrupting oil path position (I) in which said operating circuits (20,21) are not communicated with each other and a float oil path position J at which said operating circuits (20,21) are communicated with each other by way of said selector valve (26,27,34) to allow said boom cylinder (5) to assume a floating condition.

2. A float circuit according to claim 1, characterised in that said selector valve (26,27,34) is manually operable between the interrupting oil path position and the float oil path position.

3. A float circuit according to claim 1, characterised in that said selector valve (27,34) is a solenoid operated valve, and further comprising electric circuit means (29,32) for alternatively positioning said solenoid operated valve (27,34) between the interrupting oil path position I and the float oil path position J, said electric circuit means (29,32) including a switch (30) of the manual contact type having a position in which said solenoid operated valve (27,34) is positioned at the interrupting oil path position I and another position in which said solenoid operated valve (27,34) is positioned at the float oil path position J.

4. A float circuit according to claim 1, characterised in that said selector valve (27) is a solenoid operated valve, and further comprising electric circuit means (32) for alternatively positioning said solenoid operated valve (27) between the interrupting oil path position I and the float oil path position J, said electric circuit means (32) including a manually operable switch (33) of the automatic returning type having a normal position in which said solenoid operated valve (27) is positioned at the interrupting oil path position I and another position in which said solenoid operated valve (27) is positioned at the float oil path position J.

5. A float circuit according to claim 4, characterised in that said electric circuit means (32) further includes a switch (30) of the manual contact type connected in series with said manually operable switch (33).

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6. A float circuit according to claim 1, characterised in that said selector valve (34) is a pilot valve, and further comprising controlling means (36) for controlling pilot pressure to act upon said pilot valve.

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7. A float circuit according to claim 6, characterised in that said controlling means (36) includes a solenoid operated valve (36) connected to said pilot valve (34), and electric circuit means (32) for controlling said solenoid operated valve (36), said electric circuit means (32) including a manually operable switch (33) of the automatic returning type having a normal position in which said pilot valve (34) is positioned at the interrupting oil path position I and another position in which said pilot valve (34) is positioned at the float oil path position J.

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8. A float circuit according to claim 7, characterised in that said electric circuit means (32) further includes a switch (30) of the manual contact type connected in series with said manually operable switch.

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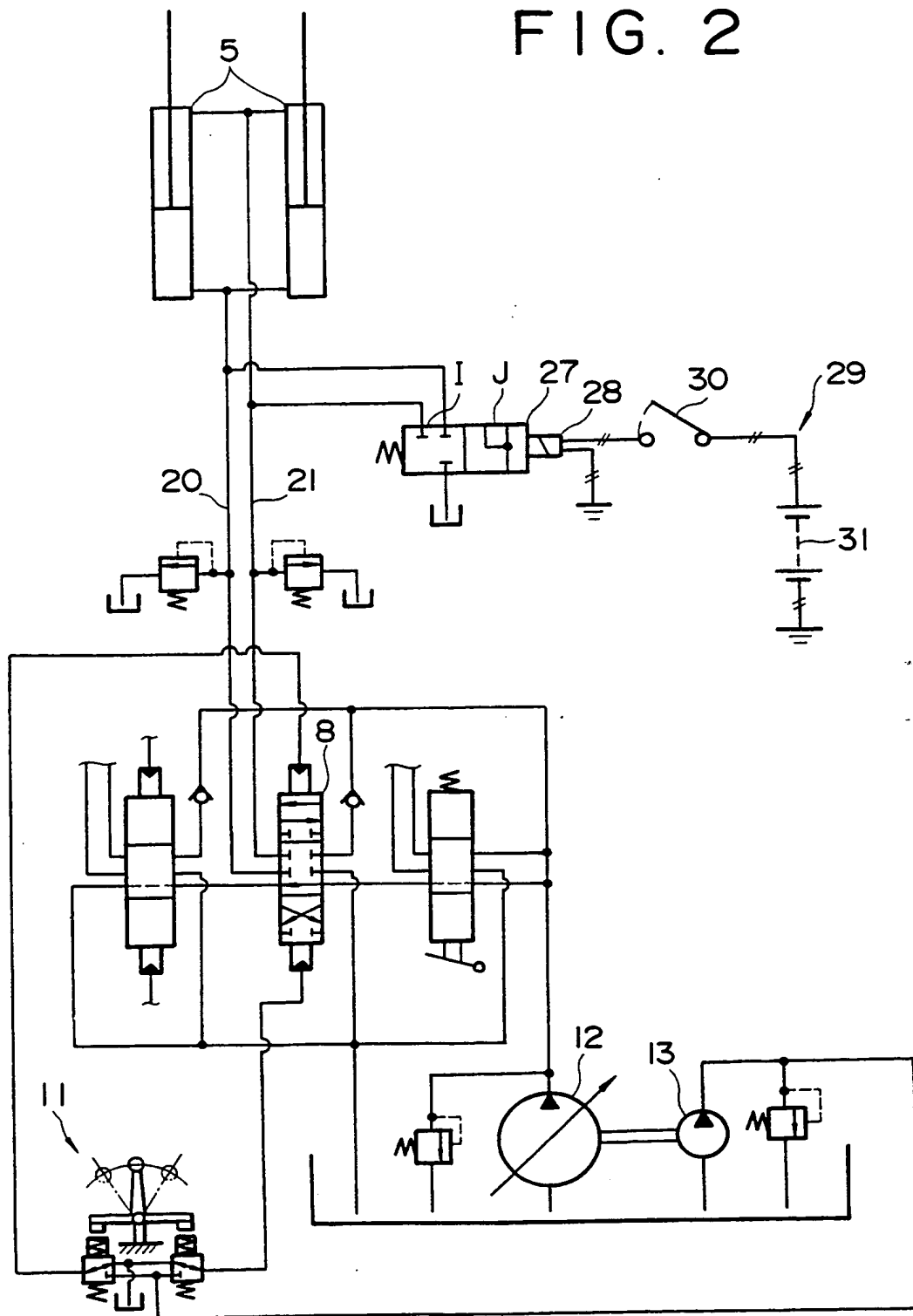
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FIG. 1

The diagram illustrates a hydraulic system. At the bottom left, a pump (11) is connected to a main line (20). A pressure-reducing valve (12) is located on the main line (20). A check valve (13) is connected to the main line (20) and a branch line (21). A solenoid valve (8) is connected to the main line (20) and the branch line (21). A solenoid valve (20) is connected to the main line (20) and the branch line (21). A solenoid valve (21) is connected to the main line (20) and the branch line (21). A solenoid valve (26) is connected to the main line (20) and the branch line (21). A solenoid valve (5) is connected to the main line (20) and the branch line (21).

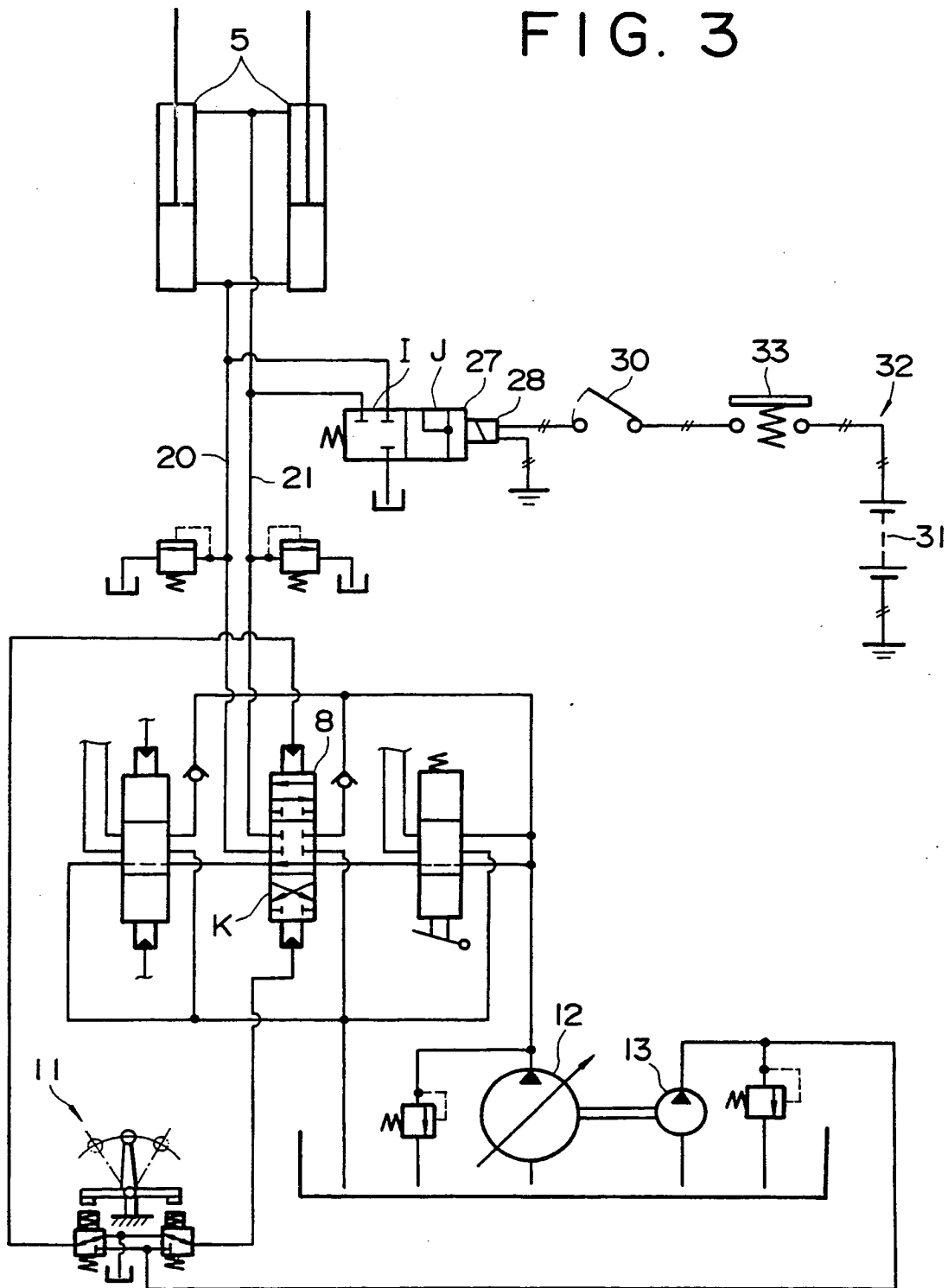
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FIG. 2



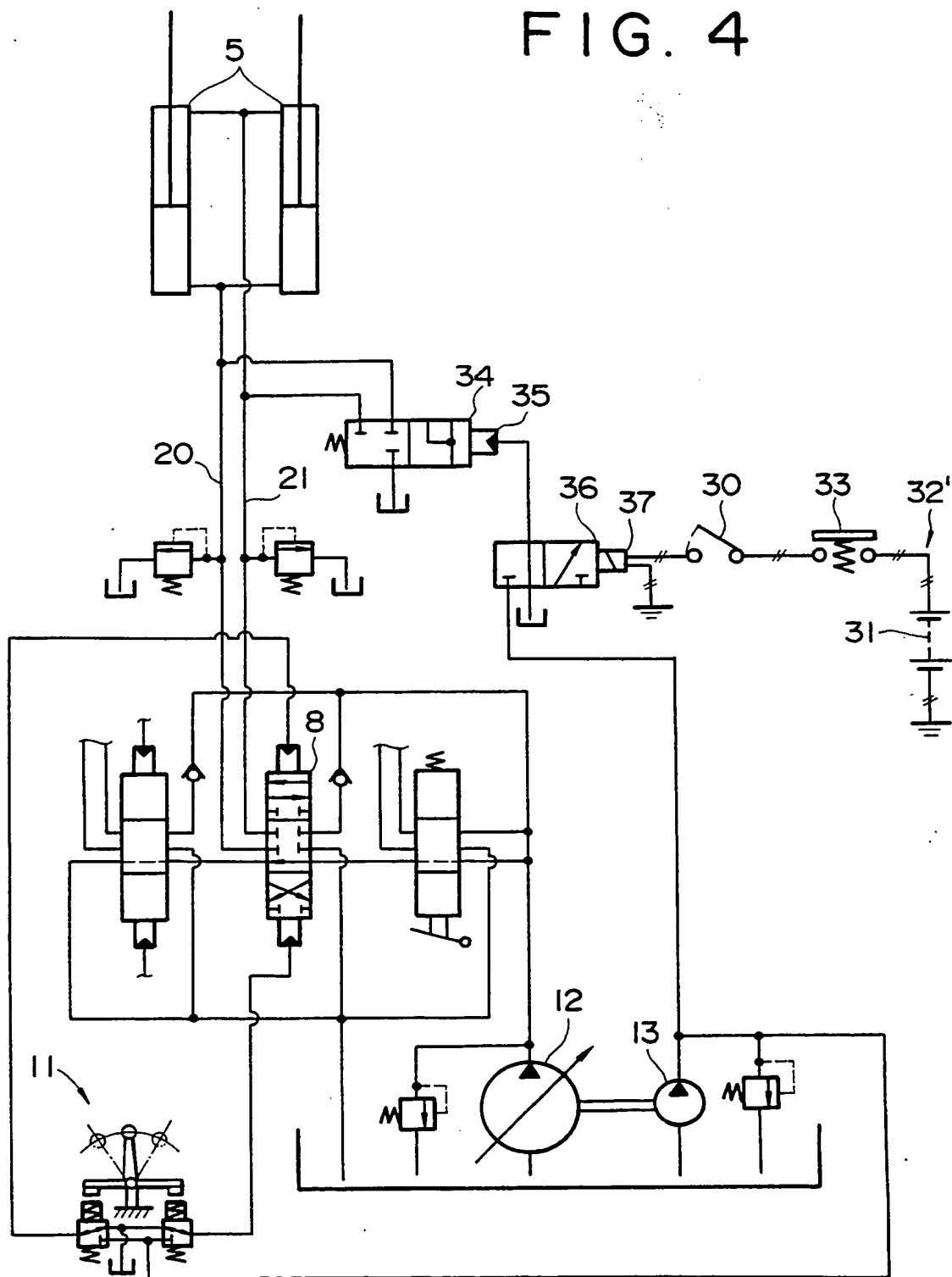
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FIG. 3



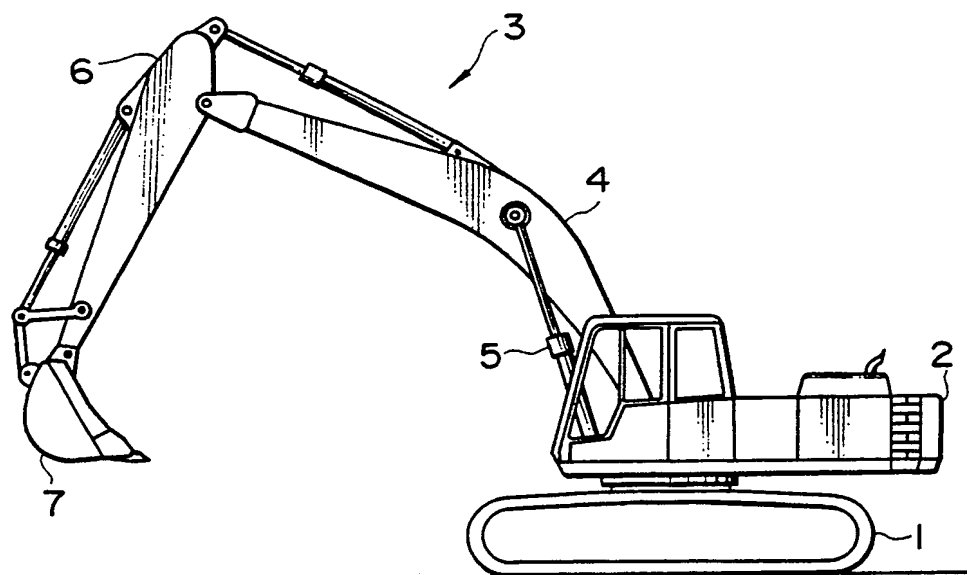
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FIG. 4



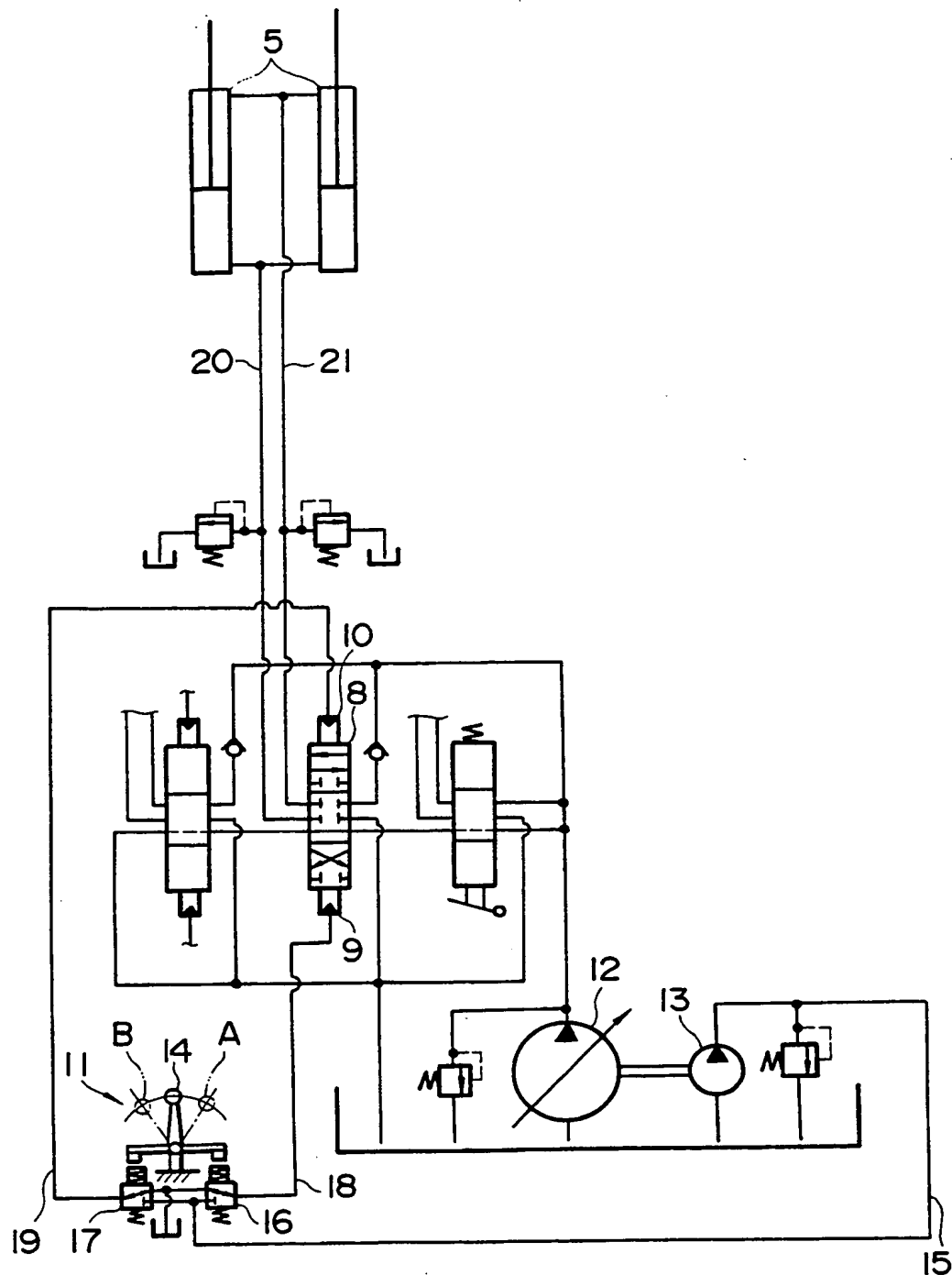
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FIG. 5



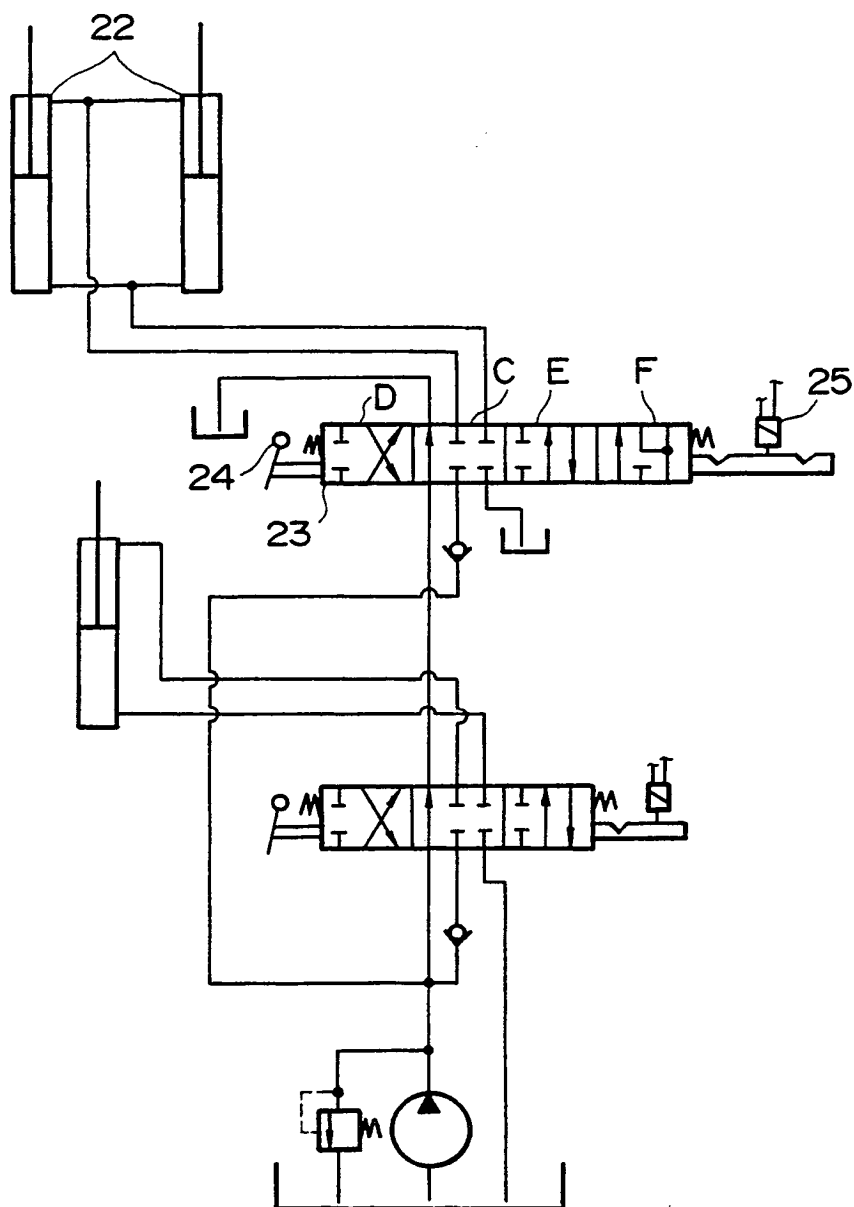
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FIG. 6



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FIG. 7





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EUROPEAN SEARCH REPORT

Application Number

EP 90 30 2288

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	PATENT ABSTRACTS OF JAPAN, vol. 10, no. 246 (M-510)[2302], 23rd August 1986; & JP-A-61 75 132 (SEIKITAN ROTENBORI KIKAI GIJUTSU KENKYU KUMIAI) 17-04-1986 * Abstract * ---	1,4,6,8	E 02 F 3/32 E 02 F 3/30 E 02 F 9/22 E 02 F 9/20
X	PATENT ABSTRACTS OF JAPAN, vol. 10, no. 246 (M-510)[2302], 23rd August 1986; & JP-A-61 75 133 (SEKITAN ROTENBORI KIKAI GIJUTSU KENKYU KIUMIAI) 17-04-1986 * Abstract * ---	1,3-8	
X	US-A-3 472 127 (J.E. SCHEDT) * Column 2, lines 9-36; fig. * ---	1,2	
X	US-A-4 799 851 (SWANSON) * Column 5, lines 5-25; fig. * ---	1	
A	US-A-4 586 332 (L.F. SCHEXNAYDER) ---		
A	GB-A- 742 783 (VICKERS-ARMSTRONGS LTD) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			E 02 F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 15-06-1990	Examiner ANGIUS P.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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